UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA, SAN FRANCISCO DIVISION

WAYMO LLC,
Plaintiff,

vs.

UBER TECHNOLOGIES, INC.; OTTOMOTTO LLC; OTTO TRUCKING LLC,
Defendants.

CASE NO. 3:17-cv-00939

REPLY DECLARATION OF GREGORY KINTZ

UNREDACTED VERSION OF DOCUMENT SOUGHT TO BE SEALED

I, Gregory Kintz, hereby declare as follows.

1. I have been asked by counsel for Waymo LLC ("Waymo") to provide an opinion as to whether Defendant Ottomotto LLC ("OttoMotto"), Defendant Otto Trucking LLC ("Otto Trucking"), or Defendant Uber Technologies, Inc. ("Uber", and collectively, "Defendants"), through the accused LiDAR devices, infringe United States Patent Nos. 8,836,922 ("the '922 Patent") and 9,285,464 ("the '464 Patent) (collectively, "the Asserted Patents"). I have also been asked to provide an opinion on Waymo's trade secrets incorporated into the accused LiDAR devices. The analysis and opinions contained in this declaration are based on the information currently available to me. I reserve the right to supplement and amend my opinions after further discovery.

2. In addition to the materials I considered in my Original Declaration, I have considered the following materials for this Reply Declaration:

- Transcripts of depositions taken pursuant to the Court's order regarding expedited discovery (Dkt No. 61);
- Documents produced by the parties pursuant to the Court's order regarding expedited discovery (Dkt No. 61);
- Defendant's opposition to Waymo's preliminary injunction, including the supporting declarations and materials cited therein;
- A physical inspection of Defendants' Fuji LiDAR device and Owl LiDAR device;
- Photographs taken from an inspection of Defendants' Spider LiDAR device.

I. TRADE SECRETS DISCUSSED IN MY ORIGINAL DECLARATION

3. In this section I address trade secrets discussed in my Original Declaration. Specifically, I respond in relevant part to the declarations of Drs. Paul McManamon and Michael Lebby, and also discuss evidence that has become available since I submitted my Original Declaration.

[redacted]

[redacted]

4. As I wrote in my Original Declaration (Kintz Decl. ¶¶ 29-35), Waymo's GBr3 features [redacted]

[redacted]. The [redacted] results in a [redacted] in the field of view that [redacted] and a [redacted] in the field of view that [redacted]. In addition, each diode is [redacted]. These design features improve the "vision" of the LiDAR system by [redacted] Further, the Fuji PCB incorporates the [redacted] concept of GBr3.

5. ***Use by Defendants.*** My visual inspection of the Fuji device on April 11, 2017 confirmed that the Fuji device features [redacted] Like the GBr3 device, the [redacted] in the Fuji device results in a [redacted] that [redacted] and a [redacted] are used in the field of view that [redacted]. Below are photographs from my physical inspection that illustrate this specific [redacted].

(Jaffe Reply Decl. Ex. 93, UBER00006245.)

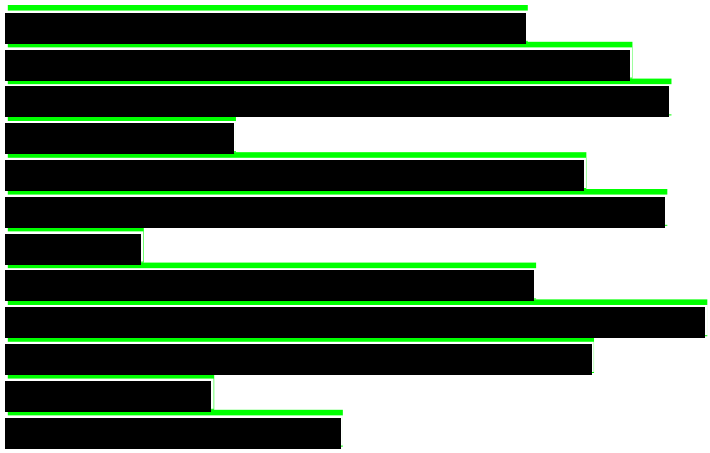
6. Neither Dr. McManamon nor Dr. Lebby denies that the Fuji system uses this design. Documentary evidence produced by Uber confirms that the Fuji device features [redacted]

[redacted]. Exhibit B to Mr. Haslim's declaration shows the [redacted] in the Fuji device, referenced to [redacted]. (Haslim Decl. Ex. B.) Using transmit board A as an example, the [redacted] between [redacted]. (*Id.*)

7. ***Qualification as Trade Secret.*** Dr. McManamon cites two references that he opines disclose [redacted] that Waymo claims as a trade secret. However, as most clearly stated in Trade Secret No. 1, [redacted] (TS List No. 1.) Neither of Dr. McManamon's two cited references discloses this feature.

8. Dr. McManamon's first cited reference is Mundhenk et al., "PanDAR: A wide-area, frame-rate, and full color LIDAR with foveated region using backfilling interpolation upsampling." Dr. McManamon claims that this is an application of the well-known optical concept called foveated vision. I agree that PanDAR implements the concept of foveated vision, *i.e.*, the concept of "[h]aving greater resolution in the middle of the field of view." (McManamon Decl. ¶ 51.) The PanDAR system, however, achieved this by stacking two Velodyne 32E LiDAR systems on top of each other, resulting in more beams in the middle of the field of view. This is distinct from an approach in which [redacted]. Indeed, Dr. McManamon agreed at his deposition that the approach taught by the PanDAR system did not use Waymo's [redacted] approach:

[redacted]



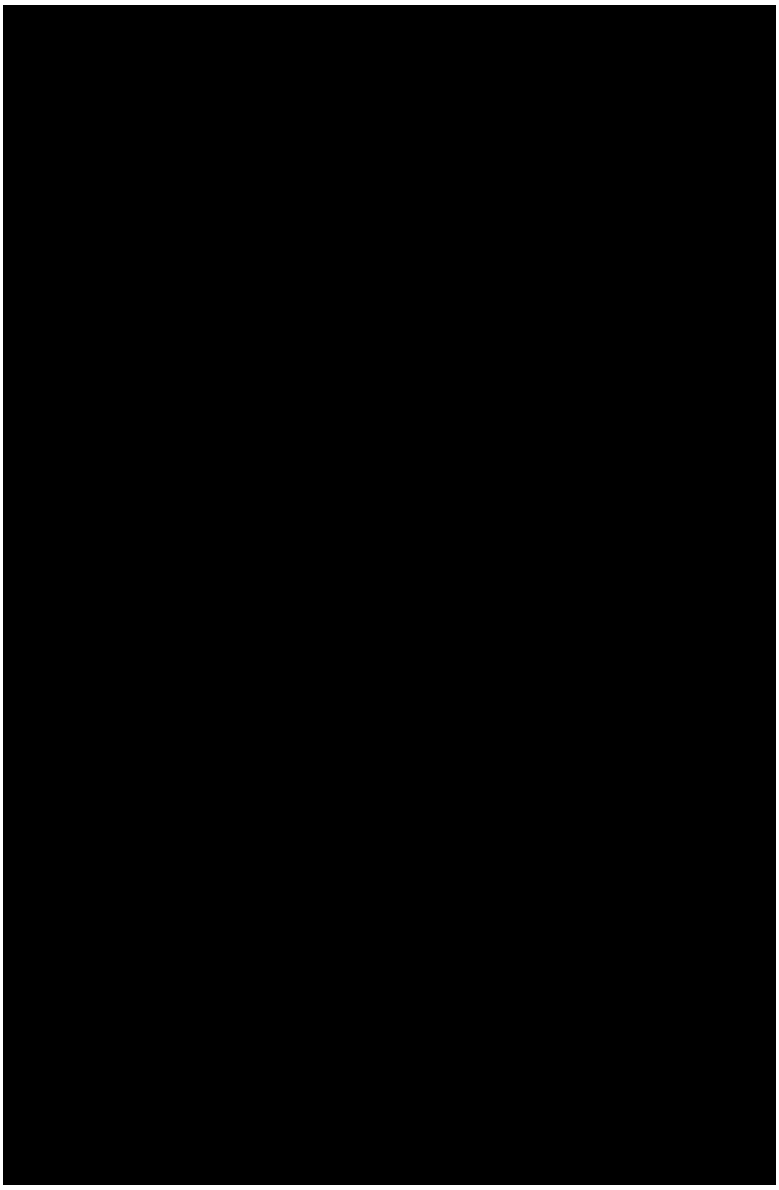
(Jaffe Reply Decl. Ex. 83, 4/19/2017 McManamon Depo. Tr. 57:25-58:14.) Adding further support to my opinion that the "dual stacked" Velodyne approach used by the PanDAR system is distinct from Waymo's [redacted] is the fact that Uber itself considered, and ultimately rejected, such a dual-stacked approach in favor of the [redacted] approach misappropriated from Waymo. (*See* Boehmke Decl. ¶¶ 9-11, 14-16, Ex. H at 5.)

9. Unlike the design taught by the PanDAR reference, Waymo's [redacted] resulting in [redacted] not at the middle of the field of view as would be the case if Waymo had just been applying the principle of foveated vision. Accordingly, I disagree with Dr. McManamon that this trade secret is simply an implementation of foveated vision. Instead, it is one of Waymo's particular solutions to the problem of sensing for self-driving car applications.

10. Dr. McManamon also relies on U.S. Patent No. 8,767,190 to Velodyne. However, this patent discloses placing one laser diode per PCB and mounting 32 PCBs on a frame, with even angular spacing between each laser diode. It then teaches varying the overall beam density of the system "by simply removing or not installing any desired number of emitter/detector pairs." ('190 patent at 6:49-50.) The patent does not teach [redacted] rather, it simply says that in some applications the designer may want to save costs by reducing the overall number of emitter/detector pairs that the system employs. It does not say that the density should be adjusted to [redacted] and it does

not teach any other specific pattern. The patent also recognizes that reducing the overall density reduces the vertical resolution of the system, which the '190 patent explains may be acceptable for some applications that do not require high resolution but require cheaper sensors. ('190 patent at 6:50-52.) The '190 patent therefore is best understood as teaching a tradeoff between overall system resolution and cost. By contrast, Waymo's solution [redacted] At his deposition, Dr. McManamon admitted that he did not cite a specific disclosure from the '190 patent describing [redacted] (Jaffe Reply Decl. Ex. 83, 4/19/2017 McManamon Depo. Tr. 61:9-12.)

11. Dr. McManamon's annotated Figure 5 of the '190 patent, at paragraph 57 of his declaration and reproduced below, does not appear in the patent itself and does not correspond to any specific embodiment disclosed by the patent. Rather, Dr. McManamon has simply attempted to use hindsight to annotate Figure 5 so that it superficially resembles the [redacted]



12. Dr. McManamon's annotated Figure 5 also does not accurately depict Waymo's solution to the problem, apparently copied by the Fuji design. Removing certain diodes from certain boards results not only in decreased resolution as discussed above, but also results in zones of constant angular spacing. This is because the '190 patent, one-diode per PCB design, is fundamentally based on the [redacted] In other words, because [redacted] to the extent another PCB is removed, the designer eventually reaches a point where the [redacted] This is illustrated in Dr. McManamon's annotated Figure 5 for [redacted]

[redacted] Even the '190 patent's passing suggestion (at 6:61-7:7) of placing several emitters per board does not remove the inherent limitation on the system that results from having the boards themselves as [redacted]

13. Waymo's designs, by contrast, are not so restricted, with [redacted]. By using [redacted] in accordance with the constraints imposed by the [redacted], as is the case in the Velodyne '190 patent), Waymo (and Uber) are able to achieve [redacted]

14. Dr. Lebby briefly opines (Lebby Decl. ¶¶ 38-39) that the [redacted] of the GBr3 laser diodes is well-known and has previously been used in LiDAR systems. Dr. Lebby cites the same references (the PanDAR reference and the '190 patent) as Dr. McManamon, and I disagree with Dr. Lebby's opinion for the same reasons I disagree with Dr. McManamon's opinion regarding the same subject, as discussed above. In addition, I note that the two images provided in paragraph 61 of Dr. Lebby's declaration depicting a GBr3 and a Fuji transmit board look very similar, suggesting direct or derivative use of Waymo's [redacted] trade secret in the Fuji design.

15. Other than Waymo and Uber's LiDAR systems, I am not aware of any other LiDAR system that includes [redacted]. My opinion therefore remains that Waymo's unique [redacted] is a trade secret and that Uber uses that trade secret.

16. ***Uber did not independently develop*** [redacted] I understand that Dr. McManamon contends that Uber independently developed the [redacted] of the Fuji system based on work by Mr. Boehmke prior to Uber's acquisition of Anthony Levandowski's company Otto. (McManamon Decl. ¶¶ 41-48.) For the reasons set forth below, I believe these

conclusions are flawed, and I have seen no evidence that Mr. Boehmke independently developed the [redacted] for the Fuji system.

17. Dr. McManamon opines that "[f]rom November 2015 to March 2016, Mr. Boehmke worked on developing custom beam patterns and parameters for Uber's self-driving cars." (McManamon Decl. ¶ 43.) Dr. McManamon further opines that in October/November 2016, Mr. Boehmke "pulled together the design options he previously considered" and developed the "custom beam spacing and angles" and that the "positioning and orientation of the diodes on the transmit board of the Fuji design" were ultimately "based" on Mr. Boehmke's work. (*Id.* ¶ 48.) However, Dr. McManamon explained at his deposition that he had performed no analysis to verify that any of Mr. Boehmke's work actually served as the basis for, or corresponds in any way, to the eventual Fuji design. (Jaffe Reply Decl. Ex. 83, 4/19/2017 McManamon Depo. Tr. at 45:17-47:4.)

18. I also note that the neither Mr. Boehmke nor Mr. Haslim ever unequivocally state in their declarations that Mr. Boehmke's work (at any time) was the basis for the current Fuji design. The most Mr. Boehmke is willing to say is that a spreadsheet of "custom beam spacing and angles" that he prepared on November 4, 2016 (Ex. I) was "provided to" James Haslim and that Mr. Boehmke "understand[s] that James [Haslim] and his team used the data in this summary to generate the initial optical cavity designs and transmit PCBs designs for the Fuji design." (Boehmke Decl. ¶ 18.) Mr. Haslim also states that he "understands" Mr. Boehmke to have provided such information. (Haslim Decl. ¶ 6.) But, Mr. Haslim never explains how—or even whether—the information provided by Mr. Boehmke was used. Later, Mr. Haslim states that Exhibit B to his declaration "is a true and correct copy of the specific position and orientation of each diode on transmit PCBs" of the Fuji system, but here he makes no connection between Exhibit B and any of the work that Mr. Boehmke allegedly provided in November 2016. (*Id.* ¶ 15.)

19. Based on my independent analysis of the evidence, I conclude that the [redacted] of the Fuji design could not have been independently developed by Mr. Boehmke prior to his exposure to Otto, because the designs Mr. Boehmke was considering at this time were very different. For example, the [redacted] depicted at paragraph 8 of the Boehmke Declaration and at paragraph 43 of the McManamon Declaration do not show a [redacted] but rather [redacted]. While the [redacted] they are [redacted] Also the [redacted] in the sense that the [redacted] As discussed previously, this type of [redacted] is distinct from the [redacted] that Waymo claims as a trade secret and which Uber is currently using in its Fuji design.

20. I also note that there is no corroborating evidence that between November 2015 to March 2016, Mr. Boehmke ever considered positioning [redacted] While the figure shown at paragraph 12 of Mr. Boehmke's declaration shows lasers being emitted from a curved source, it is possible this figure merely corresponds to an approach similar to that described in the '190 patent, with an array of evenly spaced, one-diode PCBs, which themselves are positioned within a curved frame. Again, as previously discussed, this is distinct from Waymo's concept and the current Fuji design of [redacted]

21. The first document provided by Mr. Boehmke that shows any recognition of the ability to place multiple diodes on a single PCB is Exhibit H which is dated May 16, 2016. Here, Mr. Boehmke describes, for the first time, a "Plan B" that would involve placing "[m]uliple emitters or receivers per board," though I note the shape of the proposed board was straight-edged—not curved. (Boehmke Decl. Ex. H at 10.) In this document, Mr. Boehmke describes "[o]ne lens/board for TX, one lens/board for RX," which together was referred to as a "'Flashlight' pair." (*Id.*)

22. Importantly, at around this same time, I have reviewed documents produced by Uber that indicate Mr. Boehmke's "flashlight" concept of using multiple emitters was developed at time that he and Uber were collaborating with Otto and Mr. Levandowski in particular. For example, on May 18, 2016, Mr. Boehmke sent an email to Mr. Levandowski providing a summary of their talks, and stating, "I think we're converging nicely." (Jaffe Reply Decl. Ex. 72, UBER00008543.) Subsequent documents show that Mr. Boehmke, Mr. Levandowski, and others at Otto were working closely on designs referencing the "flashlight" concept. (Jaffe Reply Decl. Ex. 98, UBER00008553; Jaffe Reply Decl. Ex. 99, UBER00008557; Jaffe Reply Decl. Ex. 97, UBER00008494.)

23. For all of these reasons, I disagree that the evidence shows that Uber independently developed the [redacted] trade secret in the Fuji design. In my opinion, the available evidence does not directly indicate how or where Uber derived this concept, confirming my earlier opinion that it was derived from Uber's exposure to Waymo's confidential trade secrets through both Otto and Mr. Levandowski.

[redacted]

24. As I wrote [redacted] optimal spacing and, to preserve [redacted] between the [redacted] on the receive block and the [redacted] on the transmit block, Waymo used [redacted] in the transmit block. (Droz Decl. ¶ 22; TS List Nos. 2-3.) Waymo determined that the [redacted] included [redacted] on each of the [redacted] and [redacted] on each of the [redacted]. (TS List No. 3.) [redacted] is a trade secret. (TS List Nos. 2-3.)

25. ***Use by Defendants.*** Defendants have confirmed that, like GBr3, the Fuji LiDAR uses [redacted], and that [redacted] contain [redacted] and [redacted] contain [redacted]. (Haslim Decl. ¶ 13.)

26. Dr. Lebby opines that Defendants' Fuji LiDAR system does not make use of Waymo's Trade Secret Nos. 2 and 3. First, with respect to Trade Secret No. 2, Dr. Lebby takes a very narrow view of what [redacted], arguing that the [redacted], and that because of this, the [redacted] are really [redacted]. (Lebby Decl. ¶¶ 29-45.) The Fuji system, as a whole, [redacted], and viewed as a [redacted] there is [redacted]. In that [redacted], as Dr. Lebby recognizes, there are [redacted] distributed across [redacted], with [redacted] (Lebby Decl. ¶ 44.) Accordingly, it is my opinion that the Fuji system practices or at least is derived from Trade Secret No. 2, which requires a [redacted] transmit block comprised of [redacted], with [redacted]

27. Even under Dr. Lebby's narrow view, it is still my opinion that the Fuji device uses Trade Secret List No. 2. The Fuji device simply takes the [redacted] and [redacted] while still maintaining the same number of [redacted] and the same distribution of [redacted]. At most, this is a minor modification derived from Waymo's trade secret design that does not change the fundamental arrangement of components.

28. Next. Dr. Lebby takes the view that Uber's Fuji system does not use Trade Secret No. 3 because it arranges its [redacted] in [redacted] rather than in [redacted] However, this too is only a minor modification in the arrangement [redacted] that does not change the fact that Defendants have derived their design from Waymo's trade secret. It is my understanding that minor modifications, elaborations, or even improvements cannot absolve the Defendants from liability if the ultimate design is derived from Waymo's trade secret information. Uber has not provided any explanation or analysis to show that simply [redacted] changes the fundamental operation of the overall device, and I am not aware of any. Nor have Defendants provided any evidence to rebut my view that this

design is simply the result of starting with the configuration claimed in Trade Secret 3 and slightly [redacted]

29. ***Qualification as Trade Secret.*** Dr. Lebby further opines that a [redacted] is just one of the few workable configurations for the transmit block of any [redacted] (Lebby Decl. ¶ 30.)

30. In my opinion, Dr. Lebby's analysis generally relies on hindsight, starting from his knowledge of Waymo's trade secrets to reason that those trade secrets were "one of a few workable configurations." (Lebby Decl. ¶ 30.) It is clear that Waymo's specific solution to the problem of optimizing a LiDAR system for self-driving car applications is not generally known to the public or in the field, and Dr. Lebby has not cited evidence to show that any has or would arrive at Waymo's specific designs. Dr. Lebby's attempt to discount the relevance of alternative arrangements of [redacted] as not ideal (Lebby Decl. ¶ 33) is not supported by the evidence. In fact, James Haslim explained in his declaration that [redacted] (Haslim Decl. ¶ 11.) Waymo's GBr2 design used [redacted] The fact that Waymo's solution placed [redacted] and [redacted] is a novel and unexpected design and therefore a valuable trade secret, as outlined in my Original Declaration. (Kintz Decl. ¶¶ 36-43.)

31. Dr. Lebby's reliance on Xingsheng Liu's "Packaging of High Power Semiconductor Lasers" is misplaced. Liu's textbook is addressed to general principles of semiconductor laser packaging and does not specifically relate to LiDAR or other optical laser system design. Indeed, as a person of skill in the art of laser-based optical mapping systems, I would have referenced such semiconductor packaging literature for general principles but would not draw from such references any conclusions regarding what was possible or feasible in implementing the detailed design for a complex laser-based optical system such as a LiDAR system.

32. As outlined by Liu, semiconductor packaging involves placing the thin patterned semiconductor material that makes up an integrated circuit (i.e., the chips), such as a laser diode

chip, together with components in a package that can be used as part of a larger circuit, with cathodes and anodes for making connections from the chip to the larger circuit in which the chip will be used. For example, this is depicted in Figures 2.1 and 2.2 of Liu:

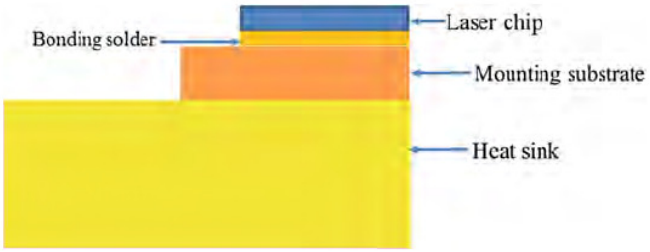


Fig. 2.1 Basic structure of a semiconductor laser [1]

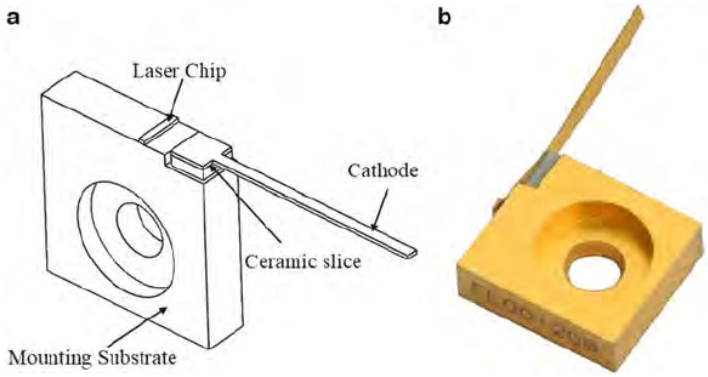


Fig. 2.2 The typical C-mount packaging structure and a picture of a C-mount laser device [1, 3]

33. As Liu explains, a laser diode package could include laser bars (such as depicted in Figure 2.17) or laser stacks (such as depicted in Figure 2.27).

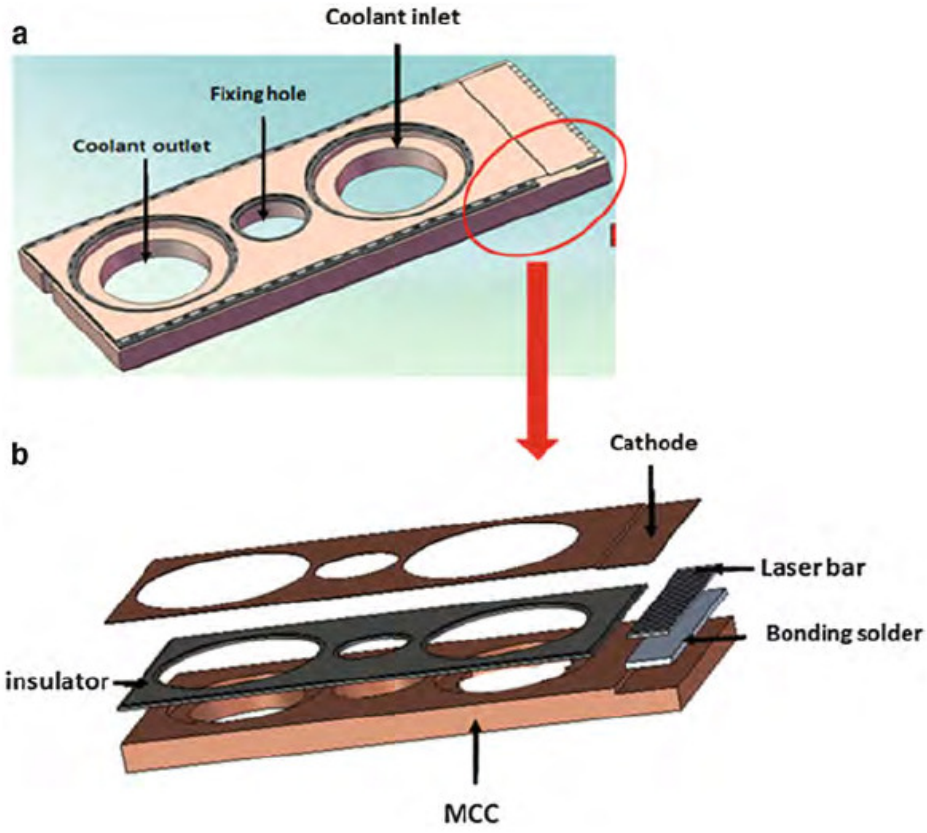


Fig. 2.17 The packaging structure of a MCC laser bar [13]

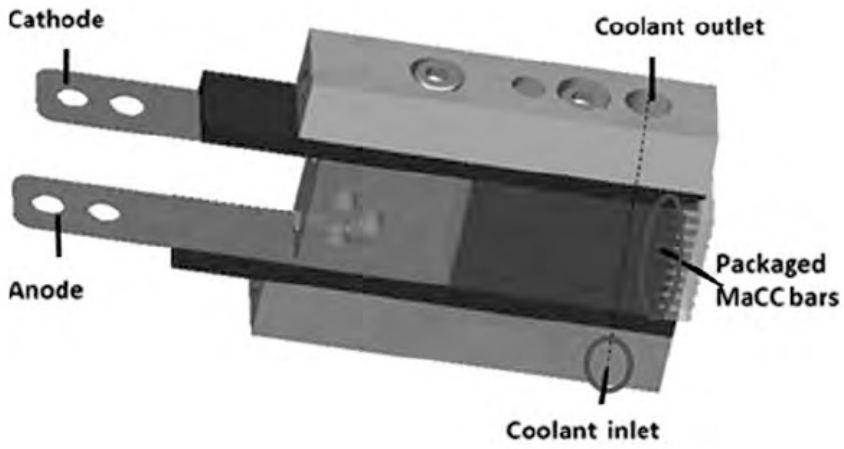


Fig. 2.27 The V-stack semiconductor laser packaged by MaCC laser bars [16]

34. As Dr. Lebby noted in his deposition, laser bars are "a single piece of semiconductor." (Jaffe Reply Decl., Ex. 84, Lebby Depo. Tr. at 52:21-22.) Moreover, packaged laser bars, and packaged laser stacks composed of multiple laser bars stacked on top of each other, are not "singulated" emitters, in that they do not produce a single output beam but instead produce

separate lines (Jaffe Reply Decl., Ex. 84, Lebby Depo. Tr. at 52:23-53:1), as depicted in Figures 5.4(b) and 5.6 of Liu, reproduced below. [redacted], as Dr. Lebby recognized in his deposition. (Jaffe Reply Decl., Ex. 84, Lebby Depo. Tr. at 53:2-4.)

Fig. 5.4 The radiation and the near-field pattern of an 808 nm semiconductor laser bar [11]. (**a**) The radiation of a semiconductor laser bar. (**b**) The near-field pattern of a semiconductor laser bar

Fig. 5.6 The far-field pattern of a semiconductor laser stack with fast axis collimation [11]

35. Nowhere does Liu teach what I have seen in both Waymo's GBr design and Uber's Fuji system, namely the [redacted]. In fact, nowhere does Liu use the word "PCB" or "board," which was Dr. Lebby's own word used to describe the laser stack in Liu Figure 5.5 noted in his deposition. (Jaffe Reply Decl. 84, Lebby Depo. Tr. at 52:15-17.) This is not surprising, as Liu is not directed to the use of laser diodes in optical systems such as a LiDAR system, but is directed merely to packaging laser diodes for potential subsequent use in larger circuits. Indeed, Waymo's GBr3 Tx Board Engineering Requirements Specification document describes [redacted]

[redacted] (P. 6.) Other than GBr and Fuji, I have not seen an optical system use [redacted]

36. Accordingly, Dr. Lebby's reliance on Figure 5.5 of Liu, in which a laser stack is depicted, is misplaced. Figure 5.5 depicts laser bars stacked directly on top of each other, with the anode of the top-most stack serving as the cathode of the middle stack and the anode of the middle stack serving as the cathode o the bottom stack. Figure 5.5 does not teach anything about using [redacted], in which the stacking does not provide the electrical connections to the laser diodes and requires use of the proprietary [redacted] developed by Waymo.

[redacted]

37. As I stated in my Original Declaration (Kintz. Decl. ¶¶ 44-48), Waymo's completed PCB design files for [redacted] are proprietary design specifications from which Defendants most likely adapted the Fuji PCB designs.

38. ***Use by Defendants.*** Dr. Lebby opines that it is not reasonable to infer that the Fuji PCB was adapted from Waymo's PCB design files. (Lebby Decl. ¶¶ 59-62). I disagree. Dr. Lebby states that the [redacted], but makes no attempt to quantify this statement. Thus, he does not counter my opinion that the Fuji PCB appears to be [redacted] of the GBr3 design files downloaded by Anthony Levandowski. As previously stated, I compared the [redacted] against the Fuji PCB by

[redacted] and measuring the [redacted] by each PCB. The ratio of the [redacted] Stated a different way, for each PCB, the ratio between the distance to the [redacted]. (Kintz Decl. ¶ 47.) This demonstrates that the Fuji PCB [redacted] to mimic the [redacted] of the Waymo board, [redacted]

39. ***Qualification as Trade Secret.*** Neither Dr. McManamon nor Dr. Lebby dispute that Waymo's detailed design schematics are confidential Waymo trade secrets.

[redacted]

40. As I stated in my Original Declaration (Kintz Decl. ¶¶ 49-53), Waymo positions its [redacted], rather than [redacted]. Known LiDAR systems strive to [redacted] for heat dissipation, but Waymo [redacted] to ensure that [redacted], while at the same time allowing space to [redacted] to both [redacted] with respect to the plane of the PCB. (TS List Nos. 7, 9.)

41. ***Use by Defendants***. Dr. Lebby does not deny that the Fuji PCB [redacted]. At Dr. Lebby's deposition, he testified that based on his discussion with Uber engineer James Haslim, [redacted]. (Jaffe Reply Decl. 84, Lebby Depo. Tr. at 58:16-23; *see also* Jaffe Reply Decl. 68, Haslim Depo. Tr. at 64:49.) This [redacted] (which is atypical in the field) is the same amount that the [redacted] in Waymo's system. Thus, Defendants are not simply using Waymo's [redacted] trade secret, they are [redacted]

42. ***Qualification as Trade Secret.*** Dr. Lebby opines that [redacted] [redacted] "is a known design choice" and therefore cannot be a trade secret. (Lebby Decl. ¶¶ 46-51.) However, Dr. Lebby again relies on the Liu textbook, as well as a 2007 dissertation (Christian Scholz, *Thermal and Mechanical Optimization of Diode Laser Bar Packaging*), in the field of semiconductor laser packaging. Again, as an optical engineer, I would consult semiconductor laser packaging literature for only general principles and would not draw from such references any conclusions regarding what was possible or feasible in implementing the detailed design for a complex laser-based optical system such as a LiDAR system. Also, I have seen no evidence that Uber or Otto relied on this or any other similar publications to design their LiDAR system. Indeed, Scholz shows that the laser bar packaging to which the dissertation is directed is three steps removed from the application, such as building a LiDAR system, and is closer to (and one step away from) semiconductor wafer chip technology.

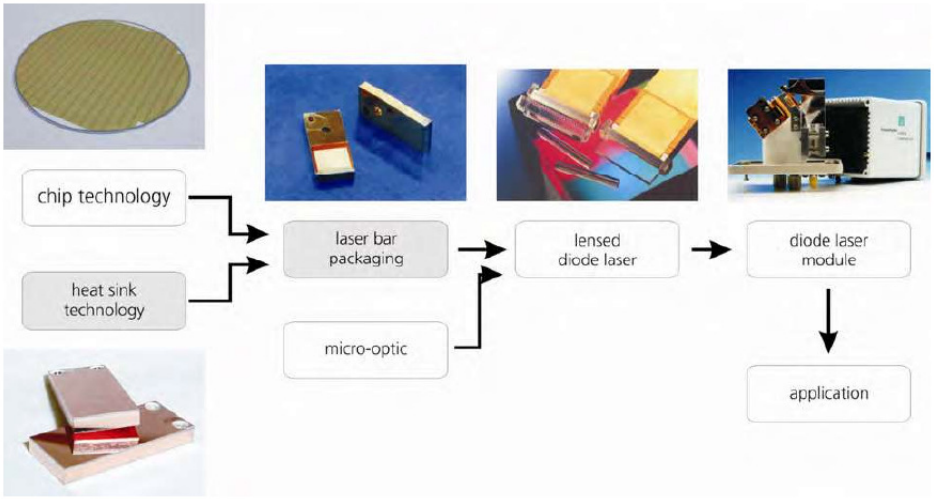


Figure 1-2: Value-added chain for diode laser bars

43. Moreover, both Liu and the Scholz dissertation teach away from using significant [redacted]. Indeed, as Dr. Lebby notes, Liu describes [redacted] as undesirable features in semiconductor packaging. (Lebby Decl. ¶ 49.) However, Dr. Lebby omits Figure 7.50, showing Liu's [redacted] from his declaration. I reproduce that Figure below.

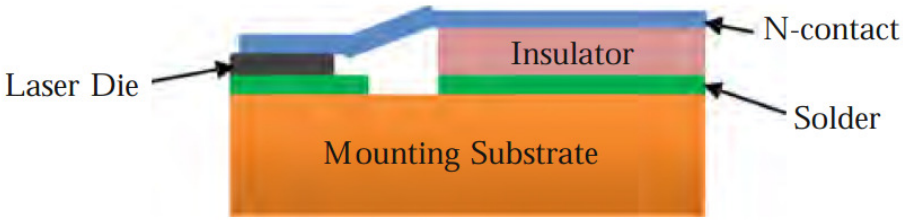


Fig. 7.50 Ideal alignment between the diode laser die and the mounting substrate [1]

44. The Scholz dissertation also does not teach Waymo's trade secret of [redacted] Scholz discusses [redacted] laser bars (i.e., strips of semiconductor material containing rows of laser diode emitters) [redacted] of the heat sink when packaging it all together. However, Scholz notes that the [redacted] which again teaches away from the trade secret. As discussed above, however, both Waymo's GBr3 LiDAR system and Uber's Fuji LiDAR system [redacted] on which they are mounted. This is [redacted]

45. I also note that Dr. Lebby ignores the additional very important benefit of [redacted] described in my Original Declaration, which is that it enables [redacted] which is directly relevant to LiDAR applications. (Kintz Decl. ¶ 50.)

[redacted]

46. As I stated in my Original Declaration (Kintz. Decl. ¶¶ 54-55), Waymo specifies that [redacted] in each PCB. A [redacted] through [redacted] ensures that [redacted], and Waymo directs for its laser diodes to be positioned [redacted] (*Id.*) Thus, [redacted] must be placed with maximum precision.

47. ***Use by Defendants***. Dr. Lebby does not deny that Defendants [redacted] In addition, Waymo engineer Asheem Linaval

testified that the Fuji PCB contains [redacted] (Jaffe Reply Decl. Ex. 65, Linaval Depo. Trans. at 59:4-12.)

48. Dr. Lebby stated that the Fuji PCB uses [redacted] (Lebby Decl. ¶ 58.) However, Exhibit B to the Haslim Declaration discloses [redacted] (Haslim Decl. Ex. B.) These points are referenced [redacted] (*Id.*) This tells me that Defendants use [redacted]—one of which is squarely within Waymo's trade secret design.

49. ***Qualification as Trade Secret.*** Dr. Lebby opines that "the concept of [redacted] and positioning laser diodes [redacted]" is not a trade secret because neither of these concepts are trade secrets. (Lebby Decl. ¶¶ 52-58.) In my opinion, Dr. Lebby mischaracterizes the nature of this trade secret. This trade secret is formulated as [redacted] (TS List No. 14.) This trade secret is an [redacted] comprised of three elements: (1) [redacted]; (2) using [redacted] for placement of the laser diodes; and (3) [redacted]. Dr. Lebby attempts to divide this trade secret into its component parts and claim that each component part was known, but the trade secret as practiced by Waymo is the combination of all elements in one technique for [redacted]

50. None of the references cited by Dr. Lebby are in the field of LiDAR, and none of the references disclose the unique combination of elements into a technique for [redacted] as claimed by Waymo so as to maintain the precise [redacted] relative to each other notwithstanding significant [redacted] for PCBs. As Waymo engineer Pierre-Yves Droz

explained in his deposition, this trade secret is about [redacted] (Jaffe Reply Decl. Ex. 90, Droz Depo. Tr. at 129:10-131:16.) The references Dr. Lebby cites do not achieve this important result.

51. Specifically, U.S. Patent No. 4,244,109 discloses only holes for mounting a single PCB onto a frame. ('109 patent at 1:66-68.) Nowhere does it disclose more than one PCB, much less [redacted], as required by this trade secret. Indeed, Dr. Lebby testified that the '109 patent shows only one printed circuit board. (Jaffe Reply Decl. Ex. 84, Lebby Depo. Tr. at 69:15-19.)

52. The German patent application No. DE 3031103 does not disclose [redacted], nor is it in the field of LiDAR or even in the wider optics field. Instead, it discloses holes made under solder bosses or tracks on PCBs so that, "[w]hen the translucent multi-layer board is held up against a strong light source, the positions of the solder bosses relative to the bored holes can be clearly seen." (DE 3031103 at Abstract.) This describes a visual alignment technique, which would be less than ideal in a LiDAR system requiring [redacted], as required by this trade secret. Dr. Lebby testified that the German patent application [redacted] (Jaffe Reply Decl. Ex. 84, Lebby Depo. Tr. 73:14.)

53. Finally, U.S. Patent No. 4,432,037, which is also not in the LiDAR or optics fields, discloses only the use of "location holes which fix a reference point" as well as "a reference line" to position conductive patterns on a single PCB. ('037 patent at 1:57-60.) Nowhere does it disclose [redacted]

54. Accordingly, the technique for [redacted] is Waymo's unique solution to the problem of [redacted] to each

other while [redacted] and is thus Waymo's trade secret.

II. TRADE SECRETS NOT DISCUSSED IN MY ORIGINAL DECLARATION

55. In this section I address trade secrets that I did not discuss in my Original Declaration. I discuss them in my Reply Declaration because new evidence has become available since March 10, 2017. I note that this list of trade secrets is not exhaustive, and I reserve the right to analyze and offer opinions about additional trade secrets as further evidence is provided.

[redacted]

56. ***Use by Defendants***. My visual inspection of the Uber Fuji device confirmed that Uber is using [redacted] This is apparent from the fact that [redacted], and [redacted] ensure that the diode is [redacted]

57. ***Qualification as Trade Secret.*** Positioning the [redacted] such that they are [redacted] is not generally known in the relevant field. As discussed earlier, PCB diodes for LiDAR applications almost always are positioned such that the [redacted] by some distance. A placement that is [redacted] has independent economic value because it allows [redacted] and thus avoid having a portion of their [redacted]

[redacted]

58. ***Use by Defendants***. Defendants do not deny that the Fuji LiDAR uses [redacted]. Further, my visual inspection of the Fuji device confirmed

that such [redacted] on the Fuji board such that they are [redacted]. As is evident from the photographs below, [redacted]

(Jaffe Repy Decl. Ex. 95, UBER00006248.)

(Jaffe Reply Decl. Ex. 96, UBER00006251.)

59. In order to accommodate the [redacted], the [redacted] must be configured within a larger [redacted]. Such a [redacted] requires a [redacted] to ensure that the [redacted]. As shown below, the overall shape and configuration of the [redacted] in Uber's Fuji design is nearly identical to that of Waymo's design, indicating that the same [redacted] is being employed by Uber.

Uber's [redacted] **Waymo's** [redacted]

(Jaffe Reply Decl. Ex. 106, UBER00011612 (left); Jaffe Opening Decl. Ex. 2 at 15 (right)),.

60. Indeed, based on documents produced in this case, it is now clear that as early as [redacted], Otto engineers, with the involvement of Mr. Levandowski, contacted [redacted]—Waymo's confidential vendor for [redacted] (Jaffe Reply Decl. Ex. 104, UBER00011613.) In fact, [redacted] (*Id.*) By [redacted], engineers at Otto [redacted] (Jaffe Reply Decl. Ex. 105, UBER00011263.) This evidence confirms that Uber is using Waymo's claimed trade secret 10.

61. ***Qualification as Trade Secret***. The [redacted] for Waymo's [redacted] qualifies as a trade secret. Providing a [redacted] for each [redacted] requires a [redacted]. Indeed, neither the Hamamatsu design, nor the Liu design cited by Dr. Lebby as characteristic of the prior art teach or suggest the [redacted] required to accommodate the [redacted] in Waymo's unique PCB configuration. The public domain [redacted] cited by Dr. Lebby are [redacted], that appear to be simply [redacted]

62. Waymo's [redacted], on the other hand, requires a [redacted] in order to ensure each [redacted] is capable of precisely aligning the [redacted] with its [redacted]. The use of such a [redacted] is atypical in the field, and would therefore not be generally known. It is therefore no surprise that the Otto engineers [redacted]

63. Waymo's manufacturing process for a [redacted] also derives independent economic value from not generally being known in the field. The [redacted] results in [redacted] Moreover, the design allows for [redacted]

[redacted]

64. ***Use by Defendants***. My visual inspection of the Fuji device confirmed the high likelihood that Defendants use this trade secret. This trade secret involves a technique for [redacted]. In order to ensure proper alignment of the optical components, the PCBs must generally [redacted]. Thus, Waymo developed a [redacted] of their corresponding PCB. These [redacted] thus ensure that the PCBs are precisely spaced and positioned.

65. During my physical inspection on April 11, 2017, I observed [redacted]. The objects do not appear to be [redacted]

(Jaffe Reply Decl. Ex. 94, UBER00006246.)

66. ***Qualification as Trade Secret***. This trade secret is not generally known in the relevant field of technology. I am not aware of any other LiDAR system that uses such [redacted] in order to ensure proper alignment of the optical equipment. Waymo's trade secret also derives independent economic value because it simplifies the assembly of the LiDAR devices and avoids the painstaking process of having to precisely align individual optical components. This technique provides Waymo a competitive advantage over competitors having no knowledge of the technique.

[redacted]

67. ***Use by Defendants***. Evidence produced since the filing of my original declaration confirms that the Defendants use this trade secret. First, an email chain between Anthony Levandowski, Daniel Gruver, and others demonstrates that as early as May 2016, Otto was developing [redacted] (Jaffe Reply Decl. Ex. 100, UBER00011242.) In the first email of the chain, Daniel Ratner explains, [redacted] (*Id.*) In a follow up email, Daniel Gruver described the device as

implementing [redacted]

(*Id.*) Benjamin Becker responded later in the chain, comparing [redacted]

[redacted] (*Id.*)

68. My inspection of Uber's Fuji device confirmed that it is using Trade Secret No. 19. [redacted] allows the device to [redacted] including the motherboard housed in the fixed portion of the device. (Jaffe Reply Decl. Ex. 110, UBER00006261.)

69. I note that Dr. McManamon addressed this trade secret, but did not dispute that Uber uses it. (McManamon Decl. ¶ 63.)

70. ***Qualification as Trade Secret***. This trade secret is not generally known in the relevant field of technology. I am not aware of any other LiDAR system that includes a [redacted] Dr. McManamon's declaration states that this design is "commonplace," but does not cite any evidence to support that argument. (McManamon Decl. ¶ 63.) I disagree with Dr. McManamon's characterization.

71. Waymo's trade secret also derives independent economic value because it allows Waymo's LiDAR system to [redacted] without interfering with the device's ability to rotate and therefore take 360-degree measurements.

[redacted]

72. ***Use by Defendants***. My review of the relevant documentation in this case, including documents produced by Uber indicates a high likelihood that Uber has or is currently using Google's trade secret concepts relating to [redacted].

73. As part of its next generation hybrid medium- and long- range LiDAR system, Waymo developed a specific design involving a [redacted] is depicted in, for example, the schematic provided below:

[redacted]

(Jaffe Opening Decl. Ex. 18 at 7.)

74. Uber's document production indicates that Odin Wave (a predecessor to Tyto LiDAR, which was subsequently acquired by Otto) was developing schematics involving a similar [redacted]. For example, the schematic shown at UBER00005076 [redacted] These documents therefore indicate that Odin Wave/Tyto LiDAR was developing the same [redacted] as was being developed at Waymo. [redacted] was then made available to Otto and Uber as its schematics were produced from Uber's custodial files.

(Jaffe Reply Decl. Ex. 92, UBER00005076 (left), UBER00005077 (right).)

75. A physical inspection of Uber's "Spider" LiDAR device provides further support for my conclusion that Uber acquired, and was seeking to leverage, Waymo's [redacted] Although I have not yet had the opportunity to personally inspect the Spider device, photographs from an April 19, 2017 inspection, such as those set forth below, indicate that this device is using [redacted]

(Jaffe Reply Decl. Ex. 101, UBER00011676 (left); Jaffe Reply Decl. Ex. 107, UBER00011678 (right).)

76. Additionally, to implement [redacted] like that described in Waymo's documents and embodied by Uber's Spider system, a person of skill in the art would understand that it would be desirable to [redacted]

[redacted] Waymo Trade Secret No. 48 relates to Waymo's time and effort to discover the appropriate [redacted]

77. The documents produced in this case show that Otto/Uber is seeking to leverage Waymo's research into [redacted] For example, on August 10, 2016, in response to an email regarding [redacted], Anthony Levandowski responded [redacted] Otto engineer Sameer Khirshagar testified at his deposition that Mr. Levandowski was [redacted] used in Uber's "Spider" LiDAR system. (Jaffe Reply Decl. Ex. 91, Khirshagar Dep. at 34:6-37:4.)

78. ***Qualification as Trade Secret***. Waymo's [redacted] implemented with an [redacted] is unique, and not generally known in the relevant field. Waymo's implementation requires a [redacted] using [redacted] and it is [redacted] that allow the [redacted]

79. Waymo's [redacted] technique enabled by its [redacted] derives independent economic value by virtue of the fact that it is not generally known in the field. Achieving this [redacted] greatly simplifies the overall circuitry and makes the design less expensive. Moreover, the use of [redacted] allows [redacted] The ability to design a LiDAR device leveraging this technology is a competitive advantage to the extent that others in the relevant field do not possess the knowledge of Google circuit design and [redacted] approach.

III. THE '922 AND '464 PATENTS

80. Since my Original Declaration, I have inspected the Fuji system and reviewed the limited technical documentation made available by Defendants related to that system. While I believe my original opinions were reasonable based on the information then available, the newly

provided information requires me to withdraw my opinion that the Fuji system infringes the '922 and '464 patents. I reserve the right to re-allege that this system infringes these patents at a later date if new evidence becomes available supporting such an opinion.

81. Since my original declaration, Defendants have produced documents and testimony regarding another of their LiDAR designs, called Spider. I have not yet had an opportunity to personally inspect the Spider device, but I have reviewed available documentation, deposition testimony, and photographs of the Spider system in forming my opinions herein.

82. As discussed in my original declaration, Otto filed a submission with the Nevada Department of Motor Vehicles on September 19, 2016, indicating that is was developing and/or deploying an "In-house custom built 64-laser (Class 1) emitting 6.4 million beams a second at 10 Hz." It is my opinion that this device most likely corresponds to the Spider device that the Defendants recently made available for inspection. Like the device described in the Nevada submission, the Spider device is designed to include 64 lasers. Spider positions these lasers in eight optical cavities, each including eight lasers. The lasers operate at 1550 nanometers, and are considered Class 1 devices. I understand Defendants have represent that the Spider device was designed to emit 3.2 million beams per second rather than 6.4 million as disclosed in the Nevada submission; however, it would not be surprising if Otto changed this target over time, or increased the rotational frequency of the device in order to obtain a comparable amount of data. The development timeline for the Spider and Fuji devices supports my conclusion that the Nevada submission was referring to the Spider device. Otto filed the submission on September 19, 2016, and according to Mr. Haslim and Mr. Boehmke, Uber did not begin working on the Fuji device until late October 2016. Accordingly, Spider is the only device that I am aware of Otto developing at the time of the Nevada submission.

83. My opinion is that the available evidence suggests that there is a high likelihood Spider system uses a single lens to both transmit and receive beams, uses multiple light emitters and multiple detectors, passes outgoing light through a hole in a mirror, passes incoming object-reflected light off of that mirror onto the receive board, and that there is partial overlap between

the transmit and receive paths. (Jaffe Reply Decl. Ex. 68, Haslim Dep. at 45:22-48:15; Jaffe Reply Decl. Ex. 67, Boehmke Dep. at 44:8-45:14.)

(Jaffe Reply Decl. Ex. 88, UBER00011654.)

84. Thus, it is my opinion that the Spider system infringes at least one claim of each the '922 and '464 patents, as shown in the exemplary claim charts set forth below.

'922 Patent	
Claim 1 Element	**Evidence**
a lens mounted to a housing, wherein the housing is configured to rotate about an axis and has an interior space that includes a transmit block, a receive block, a transmit path, and a receive path, wherein the transmit block has an exit aperture in a wall that comprises a reflective surface, wherein the receive block has an entrance aperture, wherein the transmit path extends from the exit aperture to the lens, and wherein the receive path extends from the lens to the entrance aperture via the reflective surface;	Spider included a rotating housing. (Boehmke Decl. Ex. H at 14 ("Rotate assembly at 20Hz") (Mr. Boehmke testified that "Plan C" described in Exhibit H to his declaration "was the Spider." (Jaffe Reply Decl. Ex. 67, Boehmke Depo. Tr. at 58:21-22.)); (Jaffe Reply Decl. Ex. 87, UBER00011631.) That housing was designed for eight optical cavities ("interior space[s]"), each with a transmit block, a receive block, a transmit path, and a receive path. (Jaffe Reply Decl. Ex. 64, Pennecot Depo. Tr. at 36:16-25.) The transmit path would extend from each laser to the lens, and the receive path would come back through the same lens, and then bounce off a mirror ("reflective surface") and into the receive block. (Jaffe Reply Decl. Ex. 68, Haslim Depo. Tr. at 47:9-19; Jaffe Reply Decl. Ex. 67, Boehmke Depo. Tr. at 44:8-45:14; Jaffe Reply Decl. Ex. 82, Gruver Depo.

	Tr. at 67:15-22; Jaffe Reply Decl. Ex. 64, Pennecot Depo. Tr. at 37:1-13.)
a plurality of light sources in the transmit block, wherein the plurality of light sources are configured to emit a plurality of light beams through the exit aperture in a plurality of different directions, the light beams comprising light having wavelengths in a wavelength range;	Each Spider optical cavity has eight lasers in each transmit block. (Jaffe Reply Decl. Ex. 68, Haslim Depo. Tr. at 46:18-20.) These eight lasers of a certain wavelength (1550 nm) all went through the exit aperture in different directions. (Jaffe Reply Decl. Ex. 82, Gruver Depo. Tr. at 68:5-15); (Boehmke Decl. Ex. H at 13-14.)
a plurality of detectors in the receive block, wherein the plurality of detectors are configured to detect light having wavelengths in the wavelength range; and	Each Spider optical cavity has eight avalanche photodiodes as detectors in the receive block, detecting the 1550nm laser beams. (Jaffe Reply Decl. Ex. 68, Haslim Depo. Tr. at 45:25-46:1; Jaffe Reply Decl. Ex. 82, Gruver Depo. Tr. at 68:5-15); (Boehmke Decl. Ex. H at 13.)
wherein the lens is configured to receive the light beams via the transmit path, collimate the light beams for transmission into an environment of the LIDAR device, collect light comprising light from one or more of the collimated light beams reflected by one or more objects in the environment of the LIDAR device, and focus the collected light onto the detectors via the receive path.	Finally, in each optical cavity, Spider had a single lens collimating the transmitted light into the environment and collecting and focusing the reflected light onto the detectors. (Jaffe Reply Decl. Ex. 68, Haslim Depo. Tr. at 47:9-19; Jaffe Reply Decl. Ex. 67, Boehmke Depo. Tr. at 44:8-45:14; Jaffe Reply Decl. Ex. 82, Gruver Depo. Tr. at 67:23-68:4.) The single lens mounted on a Spider optical cavity is depicted at: (Jaffe Reply Decl. Ex. 88, UBER00011654.)

'464 Patent	
Claim 1 Element	**Evidence**
a lens mounted to a housing, wherein the housing is configured to rotate about an axis and has an interior space that includes a transmit block, a receive block, a transmit path, and a receive path, wherein the transmit block has an exit aperture, wherein the receive block has an entrance aperture, wherein the transmit path extends from the exit aperture to the lens, wherein the receive path extends from the lens to the entrance	Spider included a rotating housing. (Boehmke Decl. Ex. H at 14 ("Rotate assembly at 20Hz") (Mr. Boehmke testified that "Plan C" described in Exhibit H to his declaration "was the Spider." (Jaffe Reply Decl. Ex. 67, Boehmke Depo. Tr. at 58:21-22.)); (Jaffe Reply Decl. Ex. 87, UBER00011631.) That housing was designed for eight optical

aperture, and wherein the transmit path at least partially overlaps the receive path in the interior space between the transmit block and the receive block;	cavities ("interior space[s]"), each with a transmit block, a receive block, a transmit path, and a receive path. (Jaffe Reply Decl. Ex. 64, Pennecot Depo. Tr. at 36:16-25.) The transmit block has an exit aperture and the receive block has an entrance aperture. (Jaffe Reply Decl. Ex. 64, Pennecot Depo. Tr. at 37:1-16.) The transmit path would extend from the exit aperture to the lens, and the receive path would come back through the same lens to the entrance aperture. (Jaffe Reply Decl. Ex. 68, Haslim 47:9-19; Jaffe Reply Decl. Ex. 67, Boehmke 44:8-45:14; Jaffe Reply Decl. Ex. 64, Pennecot Depo. Tr. at 37:1-16.) The transmit path would at least partially overlap the receive path in the interior space between the transmit block and the receive block. (Jaffe Reply Decl. Ex. 68, Haslim 47:20-48:8; Jaffe Reply Decl. Ex. 67, Boehmke 45:8-14; Jaffe Reply Decl. Ex. 82, Gruver 67:15-18; Jaffe Reply Decl. Ex. 64, Pennecot Depo. Tr. at 37:14-38:8.)
a plurality of light sources in the transmit block, wherein the plurality of light sources are configured to emit a plurality of light beams through the exit aperture in a plurality of different directions, the light beams comprising light having wavelengths in a wavelength range;	Each Spider optical cavity has eight lasers in each transmit block. (Jaffe Reply Decl. Ex. 68, Haslim Depo. Tr. at 46:18-20.) These eight lasers of a certain wavelength (1550 nm) all went through the exit aperture in different directions. (Jaffe Reply Decl. Ex. 82, Gruver Depo. Tr. at 68:5-15); (Boehmke Decl. Ex. H at 13-14.)
a plurality of detectors in the receive block, wherein the plurality of detectors are configured to detect light having wavelengths in the wavelength range; and	Each Spider optical cavity has eight avalanche photodiodes as detectors in the receive block, detecting the 1550nm laser beams. (Jaffe Reply Decl. Ex. 68, Haslim Depo. Tr. at 45:25-46:1; Jaffe Reply Decl. Ex. 82, Gruver Depo. Tr. at 68:5-15); (Boehmke Decl. Ex. H at 13.)

wherein the lens is configured to receive the light beams via the transmit path, collimate the light beams for transmission into an environment of the LIDAR device, collect light comprising light from one or more of the collimated light beams reflected by one or more objects in the environment of the LIDAR device, and focus the collected light onto the detectors via the receive path.	Finally, in each optical cavity, Spider had a single lens collimating the transmitted light into the environment and collecting and focusing the reflected light onto the detectors. (Jaffe Reply Decl. Ex. 68, Haslim Depo. Tr. at 47:9-19; Jaffe Reply Decl. Ex. 67, Boehmke Depo. Tr. at 44:8-45:14; Jaffe Reply Decl. Ex. 82, Gruver Depo. Tr. at 67:23-68:4.) The single lens mounted on a Spider optical cavity is depicted at: (Jaffe Reply Decl. Ex. 88, UBER00011654.)

85. I reserve the right to provide more detailed opinions about infringement of the '922 and '464 patents by the Spider system after further discovery on that system.

I declare under penalty of perjury that the foregoing is true and correct.

DATED: April 21, 2017

/s/ Gregory Kintz
Gregory Kintz

SIGNATURE ATTESTATION

Pursuant to Local Rule 5-1(i)(3), I attest under penalty of perjury that concurrence in the filing of this document has been obtained from Gregory Kintz.

/s/ *Charles K. Verhoeven*
Charles K. Verhoeven